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Jeff Beno

PATENT
Atty. Docket No. 35236-00001

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:

DANIEL LOPEZ, et al.

Serial No.: 09/249,728

Filed: February 13, 1999

For: RETICLE DEFECT DETECTION USING SIMULATION

Group Art Unit: 2623

Examiner: M. Dastouri

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION - 37 C.F.R. § 1.192)

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith, in triplicate, is the Appeal Brief in the above-referenced patent application, with respect to the Notice of Appeal filed on September 12, 2003.

Serial No. 09/249,728

This Appeal Brief is being submitted on behalf of Assignee, KLA-Tencor Corporation.

Pursuant to 37 C.F.R. § 1.17(f) enclosed please find a check in the amount of $330.00 to cover the filing fee for the Appeal Brief. If any additional fees are due for the filing or the Appeal Brief, the Commissioner is authorized to charge them to Deposit Account No. 13-3735.

If there are any fees due in connection with the filing of this paper that have not been accounted for in this paper or the accompanying papers, please charge the fees to our Deposit Account No. 13-3735. If an extension of time under 37 C.F.R. 1.136 is required for the filing of this paper and is not accounted for in this paper or the accompanying papers, such an extension is requested and the fee (or any underpayment thereof) should also be charged to our Deposit Account. A duplicate copy of this page is enclosed for that purpose.

Respectfully submitted,

MITCHELL, SILBERBERG & KNUPP LLP

Dated: November 12, 2003

By Joseph Swan
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Registration No. 41,338

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APPELLANTS' BRIEF ON APPEAL TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Appellants in the above-captioned patent application appeal the final rejection of claims 1 to 22, as set forth in the Office Action dated June 13, 2003, pursuant to the Notice of Appeal which was filed on September 12, 2003.

I. REAL PARTY IN INTEREST

The real party in interest in this application is KLA-Tencor Corporation, pursuant to an assignment which was recorded at reel 9937, frame 0765 on May 6, 1999.

II. RELATED APPEALS AND INTERFERENCES

This case previously was appealed pursuant to an appeal brief that was filed on September 27, 2002. In response to that appeal brief, the Examiner re-opened prosecution and rejected the claims on different grounds. This appeal is taken from the new rejections.

III. STATUS OF CLAIMS

Claims 1 to 22 have been finally rejected and are the subject matter of this Appeal. In accordance with 37 C.F.R. § 1.192(c)(9), a copy of the claims involved in this appeal is included in Appendix A attached hereto.

IV. STATUS OF THE AMENDMENTS

No amendments have been filed subsequent to the final rejection.

V. SUMMARY OF THE INVENTION

Conventionally, integrated circuits (ICs) are manufactured by a photolithographic process, in which a light beam is projected through a photomask, or reticle, in order to produce a desired light pattern on an underlying IC semiconductor wafer. The light reaching the IC wafer interacts with resist materials on the wafer's surface to define a corresponding pattern of shapes and channels on the wafer. After additional processing, those shapes and channels form the electronic circuits of the IC. Thus, reticles play a key role in mapping the circuit patterns onto an IC wafer substrate. Similar photolithography also is used to transfer wire routing patterns onto metal layers

that subsequently are deposited on top of the semiconductor substrate, thereby forming the necessary interconnections between the semiconductor components.

In order to produce functioning integrated circuits at a high yield rate, the reticles need to be free of defects, or at least free of defects that would adversely affect the photolithographic process or the resulting IC chips. While automated techniques conventionally have been employed to identify defects in a manufactured reticle, typically each such defect still must be classified to determine whether it will have a significant adverse effect on the IC chips that the reticle will be used to manufacture. Conventionally, such classification generally has required inspection by a human operator. Such conventional inspection may involve studying the defective portion of the mask and then making a judgment based on the operator's experience and/or may involve placing the reticle into an optical emulation device (such as a simulation microscope) in order to observe the patterns produced when light is projected through the reticle. Each such inspection technique often is difficult and time-consuming, particularly given the fact that it is not uncommon for the defect detection software to identify 800 or more defects on a single reticle, with the operator having to classify each one individually.

The present invention addresses this problem by detecting reticle defects using digital image data that correspond to an image of the reticle, processing such digital image data to identify defects (e.g., using a conventional technique) and then processing at least a portion of such digital image data to simulate a response that would be produced if the reticle were utilized in a photolithographic system. Such a simulation, for example, might include only aerial image simulation (i.e., calculating the light intensities that would result on the surface of the IC) or might include aerial image simulation in combination with resist simulation processing (i.e., calculating the actual surface patterns that would result by taking into account the resist's response to the light). See Specification page 9, lines 10 to 14. A variety of photolithography simulation

programs are available, although their use conventionally has been limited mainly to reticle design, in which it is desired to know how a proposed reticle design will perform. See Specification page 9, line 15 to page 10, line 26. Accordingly, in the preferred embodiment of the invention, such off-the-shelf software is modified to permit analysis of scanned-in image data for an actual reticle, as opposed to merely simulating an idealized design representation of a reticle. See Specification page 10, line 26 to page 11, line 21.

In short, according to the present invention, once the digital image data for the reticle have been obtained (e.g., by scanning the reticle), both defect detection and defect analysis (through simulation) can be performed using the same digital image data. As a result, the benefits of a hardware emulation often can be obtained without the necessity of obtaining an optical emulator or the necessity of performing an additional manual step of placing the subject reticle into such an emulator. In addition, because the present invention uses the same data for defect detection and simulation, it is a relatively simple matter to quickly and automatically present the simulation areas of interest to an operator, in contrast to the difficulty in locating defect areas when a separate optical emulator is used. Thus, the approach of the present invention is believed to allow faster and more efficient defect detection and classification than conventional techniques would permit, thereby reducing the costs of reticle fabrication.

VI. ISSUES PRESENTED ON APPEAL

The issues are: (i) whether claims 1 to 13, 16, 17, and 19 are properly rejected under 35 U.S.C. § 102(e) over U.S. Patent 5,965,306 (Mansfield); (ii) whether claims 14, 15, 18 and 20 to 22 are properly rejected under § 103(a) over Mansfield in view of U.S. Patent 5,619,429 (Aloni); (iii) whether claims 1 to 4, 6 to 11, 13 to 17, 19, 21 and 22 are properly rejected under § 103(a) over Aloni in view of U.S. Patent 6,016,357 (Neary); (iv) whether claims 5 and 12 are properly rejected under § 103(a) over Aloni in

view of Neary and Mansfield; and (v) whether claims 18 and 20 are properly rejected under § 103(a) over Aloni in view of Neary and U.S. Patent 6,171,731 (Medvedeva).

VII. GROUPING OF THE CLAIMS

In the Office Action, the Examiner grouped the pending claims in a particular manner. However, for purposes of the present appeal, Appellants believe that the claims are more appropriately grouped as follows:

GROUP 1: Claims 1, 3 to 5, 8, 17, 18 and 21
GROUP 2: Claims 9, 11 to 14, 16, 19, 20 and 22
GROUP 3: Claims 2 and 10
GROUP 4: Claim 6
GROUP 5: Claim 7
GROUP 6: Claim 15

It is therefore Appellants' intent that, solely for purposes of the present Appeal and for refuting the specific arguments set forth by the Examiner, the claims in each of the foregoing groups will stand or fall together, except that whenever any claim in one group depends (whether directly or indirectly) from a claim that ultimately is determined to be allowable, such dependent claim also should be allowed for at least the same reasons.

VIII. ARGUMENT

DISCUSSION OF ISSUES ON APPEAL

The criteria for showing anticipation under § 102 have been set forth as follows, "For a prior art reference to anticipate in terms of 35 U.S.C. § 102, every element in the claimed invention must be shown in a single reference." In re Bond, 15 USPQ2d 1566, 1567 (Fed. Cir. 1990) (quoting Diversitech, 7 USPQ2d 1315). In addition, that single reference must arrange the elements exactly as in the claim under review, although identity of terminology is not required. Id.

It also has been held that "The identical invention must be shown in as complete detail as is contained in the . . . claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920, (Fed. Cir. 1989).

The requirements for showing anticipation under § 102 are described in M.P.E.P. § 2131 as follows:

> A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.

Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

As to inherency:

> To establish inherency, the extrinsic evidence [emphasis added] "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." Continental Can Co. v. Monsanto Co., 948 F.2d 1264, 1268, 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). "Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." Id. at 1269, 20 U.S.P.Q.2d at 1749 (quoting In re Oelrich, 666 F.2d 578, 581, 212 U.S.P.Q. 323, 326 (C.C.P.A. 1981)).

In re Robertson, (Fed. Cir. 1999) 169 F.3d 743, 745; 49 U.S.P.Q.2d 1949.

The requirements for establishing a *prima facie* case of obviousness for a § 103 rejection have been stated as follows:

> a proper analysis under § 103 requires, inter alia, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, or carry out the claimed process; and (2) whether the prior art would also have revealed that in so making or carrying out, those of ordinary skill would have a reasonable expectation of success. [citing In re Dow Chemical Co., 837 F.2d 469, 473, 5 U.S.P.Q.2D 1529, 1531 (Fed. Cir. 1988).] Both the suggestion and the reasonable expectation of success must be found in the prior art, not in the applicant's disclosure.

In re Vaeck, 947 F.2d 488, 493 (Fed. Cir. 1991).

Summarizing the requirements for a § 103 rejection, M.P.E.P. § 2142 provides that, in order to establish a *prima facie* case of obviousness, the Examiner must cite prior art references that teach or suggest all of the claim limitations, and if more than one such reference is required to disclose all such limitations, there must be some suggestion or motivation, either in the prior art references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the reference teachings.

Thus, regardless of whether a rejection is made under § 102 or § 103, the applied art must clearly disclose or suggest all of the features recited in the claims. With regard to motivation to combine prior art teachings, the Federal Circuit has held as follows:

> "This factual question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority. It is improper, in determining whether a person of ordinary skill would have been led to this combination of references, simply to "[use] that which the inventor taught against its teacher." [citation omitted]

<u>In re Lee</u>, 277 F.3d 1338, 1343-44 (2002)

As shown below, the foregoing tests for establishing anticipation under § 102 or obviousness under § 103 have not been met for any of the following groups of claims.

<u>Group 1 Claims</u>

Independent claims 1, 17 and 21 are directed to detecting defects in a reticle used in integrated circuit chip fabrication by obtaining digital image data corresponding to an image of a reticle. The digital image data are processed according to predetermined criteria to identify defects, and a response that would be produced if the reticle were utilized in a photolithographic system is simulated by processing the digital image data corresponding to the reticle.

The foregoing combination of features is not disclosed or suggested by the applied art. For example, the applied art does not appear to disclose or to suggest at least the features of processing digital image data corresponding to an image of a reticle to simulate a response that would be produced if the reticle were to be utilized in a photolithographic system.

In this regard, the § 102(e) rejection over Mansfield is believed to be inappropriate. Mansfield does not appear to say anything at all about processing digital image data corresponding to an image of a reticle in any manner whatsoever, much less processing such digital image data to simulate a response that would be produced if the reticle were to be utilized in a photolithographic system.

The following discussion addresses the portions of Mansfield that the Examiner cited as showing the feature of obtaining digital image data corresponding to the image of a reticle:

Mansfield's Abstract, lines 6-9, merely states that a certain "analysis is performed on lithographic images that represent the image that is transferred onto the semiconductor wafer by the lithography process." This portion of Mansfield does not

say anything about digital image data whatsoever, but instead only refers to an image generated by a lithographic process. In the most recent Office Action, the Examiner appears to imply that such a lithographic image corresponds to digital image data. However, there is no indication that this is the case. In fact, particularly in the context in which that term is used by Mansfield (i.e., pursuant to a lithographic process), it is more likely that the referenced lithographic images are optical (i.e., analog) images. At the very least, the term "lithographic images" cannot be said to *inherently* involve digital image data, in accordance with the standards for showing inherency set forth in Robertson, supra.

Column 2, lines 1 to 15, of Mansfield merely discusses the use of an AIMS microscope for emulating lithographic exposure conditions, and says nothing at all about digital image data.

Column 5, lines 7 to 12, merely discusses the use of *a priori* knowledge about how variations in the sizes of features on a photomask affect wafer image. It also says nothing at all about digital image data.

Column 8 line 54 to column 9 line 4 discusses use of an AIMS microscope to inspect a given mask. It also says nothing at all about digital image data.

Accordingly, not one of the cited portions of Mansfield discloses the feature of obtaining digital image data corresponding to an image of a reticle. Lacking this feature, Mansfield could not possibly have anticipated the present claims.

The following discussion addresses the portions of Mansfield that the Examiner cited as showing the feature of processing such digital image data according to predetermined criteria to identify defects:

Figures 2-4 merely illustrate flowcharts for describing general processes in connection with mask defect identification, rating and repair, with certain tasks assigned to a device manufacturer and other tasks assigned to a mask manufacturer. None of such flowcharts appears to indicate anything at all about digital image data,

much less the use of digital image data corresponding to the image of a reticle in the recited manner.

Column 6, line 44 to column 7, line 8 generally discusses the classification of defects by comparing process windows of features close to a defect with corresponding features in a mask that does not include a defect. It also says nothing at all about digital image data.

As noted above, *column 8 line 54 to column 9 line 4* discusses use of an AIMS microscope to inspect a given mask. It also says nothing at all about using digital image data according to the present claims.

Thus, not one of the cited portions of Mansfield discloses the feature of processing digital image data corresponding to an image of a reticle according to predetermined criteria to identify defects. For this additional reason, Mansfield could not possibly have anticipated the present claims.

The following discussion addresses the portions of Mansfield that the Examiner cited as showing the feature of simulating a response that would be produced if the reticle were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of a reticle:

Column 4, line 66 to column 5, line 12 generally discusses classification of defects in a mask by analyzing images of features close to a subject defect, using multiple images that approximate the image that will be printed on the wafer under different variations in the lithographic process. However, no mention whatsoever is made of digital image data corresponding to an image of a reticle or simulating any type of response by processing such digital image data.

Column 7, lines 41 to 50, generally discusses analysis of the lithographic process using various optical techniques after a lithographic metric has been defined. However, this portion of Mansfield also says nothing at all about digital image data.

Column 8 line 54 to column 9 line 20 discusses use of an AIMS microscope to inspect a given mask. It also says nothing at all about digital image data.

Thus, these portions of Mansfield are silent about the present invention's feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle (or portion thereof). For this further reason, Mansfield could not possibly have anticipated the present claims.

In short, Mansfield only appears to discuss the analysis of pre-identified defects using optical tools in order to inspect a given mask. In his preferred embodiment, Mansfield uses an AIMS microscope to simulate (or emulate) the response of a pre-defined photolithographic system. However, this simulation is optical, as can clearly be seen from a review of Mansfield's claim 27 ("wherein said lithographic images are aerial images, said aerial images being generated by an <u>imaging system</u> that emulates a lithographic exposure tool, said <u>imaging system</u> being referred to as an aerial image measurement system (AIMS)" *[emphasis added]*). The optical nature of such AIMS simulation is further evidenced by the IBM article titled, "Development and Application of a New Tool for Lithographic Mask Evaluation, the Stepper Equivalent Aerial Image Measurement System, AIMS", previously submitted by Appellants and now cited by the Examiner. Such optical simulation has nothing to at all to do with processing any digital image data to simulate a response.

In fact, the Examiner seems to acknowledge this feature of Mansfield. In the most recent Office Action, the Examiner appears to concede that all processing in Mansfield is performed on the lithographic images provided by the AIMS microscope. Assuming that this is the case, then there would be no need to simulate a response that would be produced by a reticle, by processing digital image data corresponding to the image of the reticle.

In view of the significant differences between Mansfield and the present invention, the rejection over Mansfield is believed to be inappropriate. Rather than disclosing all of the features of the present claims, Mansfied fails to disclose most, if not all, of such features.

Independent claim 21 has been rejected over Mansfield in view of Aloni, with the Examiner principally relying upon the same arguments made when rejecting independent claim 1 under Mansfield and adding Aloni solely for the purpose of disclosing a processor for executing stored program instruction steps. For the same reasons set forth above, the principal limitations of claim 21 are not believed to be shown by Mansfield. Moreover, the Examiner has not even alleged that Aloni discloses or suggests any of the above-referenced features of the present claims. For these reasons, claim 21 is believed to be allowable over any permissible combination of Mansfield and Aloni.

As to the § 103(a) rejection over Aloni in view of Neary, the Examiner acknowledges that Aloni fails to disclose or to suggest simulating a response that would be produced if a reticle (or window within the reticle) were to be utilized in a photolithographic system by processing digital image data corresponding to the reticle (or window). However, the Office Action then cites Neary as showing this feature of the invention, and asserts that it would have been obvious to combine the two references.

Appellants disagree with this characterization of Neary. While Neary simulates (or emulates) the exposure tool upon which a given mask is to be used, such simulation appears to be done optically, rather than by processing digital image data corresponding to a reticle or a portion thereof. Thus, for example, column 6 line 25 to column 7 line 4 of Neary discusses the use of an aerial image measurement tool to emulate the aerial image that would be produced by a defective mask. This tool is described in more detail at column 3, lines 55 to 65 of Neary. There, the tool is described as an AIMS microscope that is used "to <u>measure</u> the intensity of the aerial image created by <u>illuminating</u> the mask with the desired light source." *Emphasis added.* Similarly, Neary's Abstract talks about "illuminating the mask to create an aerial image of the mask". The use of <u>illumination</u> and <u>measurement</u> clearly is more characteristic of optical emulation rather than digital simulation.

Neary's aerial image measurement tool is further described as follows:

"The device includes apertures that can emulate commercially available printing tools (e.g., Nikon EXX and Microscan II and III) and has the ability to use the working wavelength of the light to be employed (248 and 365 nanometers)." Column 3, lines 61 to 65.

The foregoing references to the device including "apertures" and having "the ability to use the working wavelength of the light to be employed" also are all characteristic of an optical emulation device, and not of a device that simulates a response by processing digital image data. Moreover, as noted above and as clearly set forth in the previously cited IBM article concerning AIMS microscopes, an AIMS microscope is used to perform optical simulations (or emulations), not digital simulations.

While the referenced portion of Neary discusses the use of "a simulator to predict the ideal aerial image, for example, in the case of grouped or isolated lines, by superimposing straight lines separating by the design CD," this has nothing to do with simulating a response that would be produced if an actual reticle were to be utilized in a photolithographic system. Rather, as can be clearly seen from the foregoing quotation, such simulation only produces an <u>ideal</u> aerial image. Moreover, even that ideal aerial image does not appear to be produced by processing digital image data in any manner whatsoever, much less by processing digital image data that corresponds to an actual reticle or portion thereof.

In the Office Action, particular emphasis is placed on column 6, lines 59 to 65 of Neary. However, that portion of Neary has been reviewed in detail and is not seen to say anything at all about the feature of simulating a response of a photolithographic system by processing digital image data corresponding to an image of a reticle (or portion thereof). Rather, that portion of Neary merely discusses calculating the difference between the optically simulated aerial image for the sample mask and the projection of the ideal aerial image. Figures 2, 10 and 16 also have been reviewed, but are not seen to disclose anything that would make up for the foregoing shortfalls of Neary in this regard.

In short, neither Aloni or Neary discloses or suggests the feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle or portion thereof. Accordingly, no permissible combination of these two references would have rendered the present invention obvious.

Appellants previously have presented arguments similar to those above on numerous occasions in this case, and have even appealed once already. Despite this, there has been no specific reference to anything in the applied art references that would refute the above points.

Accordingly, independent claims 1, 17 and 21, together with their dependent claims 3 to 5, 8 and 18 are believed to be allowable over the applied art.

Group 2 Claims

Independent claims 9, 19 and 22 are directed to detecting defects in a reticle used in integrated circuit chip fabrication by obtaining digital image data corresponding to an image of a reticle and processing the digital image data according to predetermined criteria to identify defects. A window is then specified around one of the identified defects and a response that would be produced if the specified window were to be utilized in a photolithographic system is simulated by processing digital image data corresponding to the specified window.

The foregoing combination of features is not disclosed or suggested by the applied art. In particular, the applied art does not disclose or suggest at least the features of specifying a window around a defect identified in digital image data corresponding to a reticle and then simulating a response that would be produced if the specified window were to be utilized in a photolithographic system, by processing digital image data corresponding to the window.

In this regard, the § 102(e) rejection over Mansfield is believed to be inappropriate. Mansfield does not appear to say anything at all about processing digital image data corresponding to an image of a reticle in any manner whatsoever, much

less processing such digital image data to simulate a response that would be produced if the reticle were to be utilized in a photolithographic system.

The following discussion addresses the portions of Mansfield that the Examiner cited as showing the feature of obtaining digital image data corresponding to the image of a reticle:

Mansfield's Abstract, lines 6-9, merely states that a certain "analysis is performed on lithographic images that represent the image that is transferred onto the semiconductor wafer by the lithography process." This portion of Mansfield does not say anything about digital image data whatsoever, but instead only refers to an image generated by a lithographic process. In the most recent Office Action, the Examiner appears to imply that such a lithographic image corresponds to digital image data. However, there is no indication that this is the case. In fact, particularly in the context in which that term is used by Mansfield (i.e., pursuant to a lithographic process), it is more likely that the referenced lithographic images are optical (i.e., analog) images. At the very least, the term "lithographic images" cannot be said to *inherently* involve digital image data, in accordance with the standards for showing inherency set forth in Robertson, supra.

Column 2, lines 1 to 15, of Mansfield merely discusses the use of an AIMS microscope for emulating lithographic exposure conditions, and says nothing at all about digital image data.

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Column 4, line 66 to column 5, line 12 generally discusses classification of defects in a mask by analyzing images of features close to a subject defect, using multiple images that approximate the image that will be printed on the wafer under different variations in the lithographic process. However, no mention whatsoever is

made of digital image data corresponding to an image of a reticle or simulating any type of response by processing such digital image data.

Column 7, lines 41 to 50, generally discusses analysis of the lithographic process using various optical techniques after a lithographic metric has been defined. However, this portion of Mansfield also says nothing at all about digital image data.

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Thus, these portions of Mansfield are silent about the present invention's feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle (or portion thereof). For this further reason, Mansfield could not possibly have anticipated the present claims.

In short, Mansfield only appears to discuss the analysis of pre-identified defects using optical tools in order to inspect a given mask. In his preferred embodiment, Mansfield uses an AIMS microscope to simulate (or emulate) the response of a pre-defined photolithographic system. However, this simulation is optical, as can clearly be seen from a review of Mansfield's claim 27 ("wherein said lithographic images are aerial images, said aerial images being generated by an <u>imaging system</u> that emulates a lithographic exposure tool, said <u>imaging system</u> being referred to as an aerial image measurement system (AIMS)" *[emphasis added]*). The optical nature of such AIMS simulation is further evidenced by the IBM article titled, "Development and Application of a New Tool for Lithographic Mask Evaluation, the Stepper Equivalent Aerial Image Measurement System, AIMS", previously submitted by Appellants and now cited by the Examiner. Such optical simulation has nothing to at all to do with processing any digital image data to simulate a response.

In fact, the Examiner seems to acknowledge this feature of Mansfield. In the most recent Office Action, the Examiner appears to concede that all processing in Mansfield is performed on the lithographic images provided by the AIMS microscope. Assuming that this is the case, then there would be no need to simulate a response that

would be produced by a reticle, by processing digital image data corresponding to the image of the reticle.

In view of the significant differences between Mansfield and the present invention, the rejection over Mansfield is believed to be inappropriate. Rather than disclosing all of the features of the present claims, Mansfied fails to disclose most, if not all, of such features.

Independent claim 22 has been rejected over Mansfield in view of Aloni, with the Examiner principally relying upon the same arguments made when rejecting independent claim 9 under Mansfield and adding Aloni solely for the purpose of disclosing a processor for executing stored program instruction steps. For the same reasons set forth above, the principal limitations of claim 22 are not believed to be shown by Mansfield. Moreover, the Examiner has not even alleged that Aloni discloses or suggests any of the above-referenced features of the present claims. For these reasons, claim 22 is believed to be allowable over any permissible combination of Mansfield and Aloni.

As to the § 103(a) rejection over Aloni in view of Neary, the Examiner acknowledges that Aloni fails to disclose or to suggest simulating a response that would be produced if a reticle (or window within the reticle) were to be utilized in a photolithographic system by processing digital image data corresponding to the reticle (or window). However, the Office Action then cites Neary as showing this feature of the invention, and asserts that it would have been obvious to combine the two references.

Appellants disagree with this characterization of Neary. While Neary simulates (or emulates) the exposure tool upon which a given mask is to be used, such simulation appears to be done optically, rather than by processing digital image data corresponding to a reticle or a portion thereof. Thus, for example, column 6 line 25 to column 7 line 4 of Neary discusses the use of an aerial image measurement tool to emulate the aerial image that would be produced by a defective mask. This tool is described in more detail at column 3, lines 55 to 65 of Neary. There, the tool is described as an AIMS microscope that is used "to <u>measure</u> the intensity of the aerial

image created by illuminating the mask with the desired light source." *Emphasis added.* Similarly, Neary's Abstract talks about "illuminating the mask to create an aerial image of the mask". The use of illumination and measurement clearly is more characteristic of optical emulation rather than digital simulation.

Neary's aerial image measurement tool is further described as follows:

> "The device includes apertures that can emulate commercially available printing tools (e.g., Nikon EXX and Microscan II and III) and has the ability to use the working wavelength of the light to be employed (248 and 365 nanometers)." Column 3, lines 61 to 65.

The foregoing references to the device including "apertures" and having "the ability to use the working wavelength of the light to be employed" also are all characteristic of an optical emulation device, and not of a device that simulates a response by processing digital image data. Moreover, as noted above and as clearly set forth in the previously cited IBM article concerning AIMS microscopes, an AIMS microscope is used to perform optical simulations (or emulations), not digital simulations.

While the referenced portion of Neary discusses the use of "a simulator to predict the ideal aerial image, for example, in the case of grouped or isolated lines, by superimposing straight lines separating by the design CD," this has nothing to do with simulating a response that would be produced if an actual reticle were to be utilized in a photolithographic system. Rather, as can be clearly seen from the foregoing quotation, such simulation only produces an ideal aerial image. Moreover, even that ideal aerial image does not appear to be produced by processing digital image data in any manner whatsoever, much less by processing digital image data that corresponds to an actual reticle or portion thereof.

In the Office Action, particular emphasis is placed on column 6, lines 59 to 65 of Neary. However, that portion of Neary has been reviewed in detail and is not seen to say anything at all about the feature of simulating a response of a photolithographic system by processing digital image data corresponding to an image of a reticle (or portion thereof). Rather, that portion of Neary merely discusses calculating the difference between the optically simulated aerial image for the sample mask and the

projection of the ideal aerial image. Figures 2, 10 and 16 also have been reviewed, but are not seen to disclose anything that would make up for the foregoing shortfalls of Neary in this regard.

In short, neither Aloni or Neary discloses or suggests the feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle or portion thereof. Accordingly, no permissible combination of these two references would have rendered the present invention obvious.

The present claims also include the feature of simulating a response that would be produced if a window that is specified around an identified defect in digital image data were to be utilized in a photolithographic system. With regard to this feature of the invention, the Examiner merely points to the two-dimensional moving window memory array 228 in Figure 12 and to column 25, line 63 to column 26, line 22 of Aloni. While that portion of Aloni does describe specifying a window around an identified defect for the purpose of postprocessing, nothing in Aloni, Neary or any combination of the two suggests simulating any response produced by such a window, much less a response as recited in the present claims. In fact, the Examiner has not even alleged that it does. Similarly, Neary appears to say nothing at all about using windows, and the Examiner has not even alleged that it does.

Appellants previously have presented arguments similar to those above on numerous occasions in this case, and have even appealed once already. Despite this, there has been no specific reference to anything in the applied art references that would refute the above points.

As a result, independent claims 9, 19 and 22, together with their dependent claims 11 to 14, 16 and 20 are believed to be allowable over the applied art.

<u>Group 3 Claims</u>

Claims 2 and 10 depend from independent claims 1 and 9, respectively, and recite the further limitation that the digital image data used for the simulation are

obtained by scanning the reticle. This feature of the invention is not disclosed or suggested by the applied art.

In this regard, in connection with the § 102 rejection, the Examiner cites column 2, lines 1-15 of Mansfield (which merely references use of the AIMS microscope) and then asserts that scanning the reticle is inherently part of the AIMS microscope. However, the Examiner has cited no extrinsic evidence to indicate that this is so, as is required by Robertson, supra. To the contrary, as noted above, the AIMS microscope optically simulates a response that would be produced by a reticle. It is possible that this optically simulated image may then be scanned (although there is no indication that it actually is). However, even if this were the case, the resulting digital image data clearly would not be used as the basis for a simulation, as presently recited. In short, in Mansfield's technique, there would be no need to scan a reticle to obtain digital image for processing to simulate the response of the reticle because simulation is performed optically.

In connection with the § 103 rejection over Aloni in view of Neary, the Examiner then cites column 9, lines 40 to 42, of Aloni as showing this feature of the invention. That portion of Aloni does discuss scanning an object to be inspected. However, there is no indication in Aloni that the resulting image data are to be used for any form of simulation, much less as recited in the present claims. Neary does not appear to even mention scanning a reticle to obtain image data, and the Examiner has not alleged that it does. Thus, neither applied reference shows this feature of the invention. In addition, it is noted that Neary also does not suggest simulating a reticle by using image data of the type produced by Aloni's scanning operation. Accordingly, there would have been no motivation to combine Neary with Aloni in any manner that would have provided the present feature of the invention.

For these additional reasons, claims 2 and 10 are believed to be allowable over the applied art.

Group 4 Claim

Claim 6 depends from independent claim 1 and recites the further limitation that the digital image data used for the simulation are in raster format. This feature of the invention is not disclosed or suggested by the applied art.

In this regard, in connection with the § 102 rejection, the Examiner cites column 2, lines 1-15 of Mansfield (which merely references use of the AIMS microscope) and then asserts that scanning the reticle is inherently part of the AIMS microscope. However, the Examiner has cited no extrinsic evidence to indicate that this is so, as is required by Robertson, supra. To the contrary, as noted above, the AIMS microscope optically simulates a response that would be produced by a reticle. It is possible that this optically simulated image may then be scanned (although there is no indication that it actually is). However, even if this were the case, the resulting digital image data clearly would not be used as the basis for a simulation, as presently recited. In short, in Mansfield's technique, there would be no need to scan a reticle to obtain digital image for processing to simulate the response of the reticle because simulation is performed optically.

Then, in connection with the § 103 rejection over Aloni in view of Neary, the Examiner cites column 9, lines 40 to 42, of Aloni and asserts that a digital image inherently is in raster format. Appellants acknowledge that the cited portion of Aloni discusses scanning an object to be inspected, and Appellants agree that scanned image data typically are initially in raster format. However, there is no indication in Aloni that the resulting raster image data are to be used for any form of simulation, much less as recited in the present claims, and the Examiner has not even alleged that it does. Also, Neary does not appear to even mention using reticle image data in raster format, and the Examiner has not alleged that it does. Accordingly, there would have been no motivation to combine Neary with Aloni in any manner that would have provided the above-referenced feature of the invention.

For these additional reasons, claim 6 is believed to be allowable over the applied art.

Group 5 Claim

Claim 7 depends from independent claim 1 and recites the further limitation that a format of the digital image data is modified prior to performing the simulation. This feature of the invention is not disclosed or suggested by the applied art.

In this regard, in connection with the § 102 rejection, the Examiner cites column 10, lines 4-33 of Mansfield. However, that portion of Mansfield merely discusses alteration (or pre-distortion) of photomask design data to compensate for distortions that are anticipated to occur when the photomask is used in an actual fabrication process. It says nothing at all about modifying the format of digital image data corresponding to an image of a reticle prior to performing a simulation with such digital image data.

Then, in connection with the § 103 rejection over Aloni in view of Neary, the Examiner has cited Figure 3 and column 4, lines 28 to 37, of Neary as showing this feature. However, Figure 3 merely shows, and the cited textual portion merely describes, the physical operation of cutting away or trimming the ragged portion of a defect and then observing the resulting light pattern prior to repairing the defect. This optional trimming step is a physical operation performed on the mask under observation in Neary's system and has nothing at all to do with modifying the format of digital image data that represent a reticle prior to performing a simulation using such digital image data.

For these additional reasons, claim 7 is believed to be allowable over the applied art.

Group 6 Claim

Claim 15 depends from independent claim 9 and recites the further limitation that the digital image data processed to produce the simulation are grayscale data. This feature of the invention is not disclosed or suggested by applied art.

In this regard, the Examiner cites column 9, lines 40 to 42, of Aloni as showing this feature of the invention. That portion of Aloni does discuss scanning an object to be inspected into a grayscale representation. However, there is no indication in Aloni

that the resulting image data are to be used for any form of simulation, much less as recited in the present claims. Similarly, neither Mansfield nor Neary suggests simulating a reticle using image data of the type produced by Aloni's scanning operation, and the Examiner has not pointed to any specific portion of the applied art that would have indicated that this is the case. Rather, contrary to the holding of In Re Lee, supra, the Examiner only generally alleges that it would have been obvious to combine the teachings of Aloni with Mansfield in some unspecified manner in order to achieve the present invention. Accordingly, there would have been no permissible motivation to combine Aloni with Mansfield or Neary in any manner that would have provided the present feature of the invention.

For these additional reasons, claim 15 is believed to be allowable over the applied art.

CONCLUDING REMARKS

As Appellants have shown above, for a number of different reasons, nothing in the applied art discloses or suggests the invention recited by the claims on appeal. Appellants therefore respectfully submit that the claimed invention is patentably distinct over the applied art.

In view of the foregoing remarks, Appellants respectfully request that the rejection of claims 1 to 22 be reversed and a Notice of Allowance issued.

Respectfully submitted,

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Dated: November 12, 2003

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APPENDIX A

Claims on Appeal

1. A method for detecting defects in a reticle used in integrated circuit chip fabrication, said method comprising:

(a) obtaining digital image data corresponding to an image of a reticle;

(b) processing the digital image data according to predetermined criteria to identify defects; and

(c) simulating a response that would be produced if the reticle were to be utilized in a photolithographic system, by processing the digital image data corresponding to the reticle.

2. A method according to Claim 1, wherein the digital image data are obtained by scanning the reticle.

3. A method according to Claim 1, wherein the defects are identified in step (b) by comparing the digital image data to reference digital image data.

4. A method according to Claim 1, wherein step (c) simulates an aerial image which would be produced by the reticle.

5. A method according to Claim 1, further comprising a step of categorizing defects based on simulation results produced in step (c).

6. A method according to Claim 1, wherein the digital image data are in raster format.

7. A method according to Claim 1, further comprising a step of modifying a format of the digital image data prior to performing step (c).

8. A method according to Claim 1, further comprising a step of providing a reference simulation for comparison to a simulation produced in step (c).

9. A method for detecting defects in a reticle used in integrated circuit chip fabrication, said method comprising:

(a) obtaining digital image data corresponding to an image of a reticle;

(b) processing the digital image data according to predetermined criteria to identify defects;

(c) specifying a window around one of the defects identified in step (b); and

(d) simulating a response that would be produced if the window specified in step (c) were to be utilized in a photolithographic system, by processing digital image data corresponding to the window specified in step (c).

10. A method according to Claim 9, wherein the digital image data are obtained by scanning the reticle.

11. A method according to Claim 9, wherein step (d) simulates an aerial image which would be produced by the window.

12. A method according to Claim 9, further comprising a step of categorizing defects based on simulation results produced in step (d).

13. A method according to Claim 9, further comprising a step of simulating a window of corresponding reference image data for comparison to simulation results produced in step (d).

14. A method according to Claim 9, wherein the window is 64 x 64 pixels.

15. A method according to Claim 9, wherein the digital image data processed in step (d) are grayscale data.

16. A method according to Claim 9, wherein the defects are identified in step (b) by comparing the digital image data to reference digital image data.

17. A computer-readable medium having encoded thereon computer-executable process steps, said process steps for detecting defects in a reticle used in integrated circuit chip fabrication, wherein said process steps comprise steps to:

(a) obtain digital image data corresponding to an image of a reticle;

(b) process the digital image data according to predetermined criteria to identify defects; and

(c) simulate a response that would be produced if the reticle were to be utilized in a photolithographic system, by processing the digital image data corresponding to the reticle.

18. A computer-readable medium according to Claim 17, wherein said computer readable medium comprises at least one of a magnetic diskette, magnetic tape, a CD-ROM, a random access memory chip, and a read-only computer memory chip.

19. A computer-readable medium having encoded thereon computer-executable process steps, said process steps for detecting defects in a reticle used in integrated circuit chip fabrication, said process steps comprising steps to:

(a) obtain digital image data corresponding to an image of a reticle;

(b) process the digital image data according to predetermined criteria to identify defects;

(c) specify a window around one of the defects identified in step (b); and

(d) simulate a response that would be produced if the window specified in step (c) were to be utilized in a photolithographic system, by processing digital image data corresponding to the window specified in step (c).

20. A computer-readable medium according to Claim 19, wherein said computer readable medium comprises at least one of a magnetic diskette, magnetic tape, a CD-ROM, a random access memory chip, and a read-only computer memory chip.

21. An apparatus for detecting defects in a reticle used in integrated circuit chip fabrication, said apparatus comprising:

a processor for executing stored program instruction steps; and

a memory connected to the processor for storing the program instruction steps,

wherein the program instruction steps include steps to:

(a) obtain digital image data corresponding to an image of a reticle;

(b) process the digital image data according to predetermined criteria to identify defects; and

(c) simulate a response that would be produced if the reticle were to be utilized in a photolithographic system, by processing the digital image data corresponding to the reticle.

22. An apparatus for detecting defects in a reticle used in integrated circuit chip fabrication, said apparatus comprising:

a processor for executing stored program instruction steps; and

a memory connected to the processor for storing the program instruction steps,

wherein the program instruction steps include steps to:

(a) obtain digital image data corresponding to an image of a reticle;

(b) process the digital image data according to predetermined criteria to identify defects;

(c) specify a window around one of the defects identified in step (b); and

(d) simulate a response that would be produced if the window specified in step (c) were to be utilized in a photolithographic system, by processing digital image data corresponding to the window specified in step (c).